ACTIVITY PERIODS, HUNTING METHODS, AND EFFICIENCY OF THE FERRUGINOUS HAWK

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ABSTRACT. This paper presents some preliminary results from an ongoing study of the feeding behavior of the Ferruginous Hawk in northern Curlew Valley, Idaho. Information on activity periods, hunting methods, and success rates was obtained by direct observation of a single pair of hawks during the nestling stage. The male did all of the hunting, foraging actively throughout the day but with definite peaks in the morning and evening. About 15% of his strikes were successful; success rate depended on the method of hunting used.

The mobility of birds of prey has often prevented investigation of their activity patterns and feeding behavior. Studies of food habits by pellet analysis comprise the bulk of the raptor feeding literature. This paper presents new information on the feeding behavior of the Ferruginous Hawk (*Buteo regalis*) in southern Idaho. The study was supported, in part, by a grant from the Society of the Sigma Xi.

Study Area and Methods

From 19 May to 15 June 1974, I spent nearly 200 hours in a blind overlooking the nest and range of a single pair of Ferruginous Hawks. This observation period began when the birds' three nestlings were approximately one week of age and ended about a week before they fledged.

Using a pair of 8 x 30 binoculars and a 20x spotting scope, I watched the adult male whenever he left the vicinity of the nest and recorded his activities until he returned or was lost to view. Despite previous reports that the adult hawks often forage together (Cameron 1914, Angell 1969), all hunting by this pair was performed by the male.

The study area was in northern Curlew Valley, Idaho, approximately 10 km north of Snowville, Utah. The hawks' nesting range encompassed slightly more than 21 km^2 of patchy habitat. The nest itself was located in a solitary Utah juniper (*Juniperus osteosperma*) tree at the edge of the denser juniper forest which covered the southern foothills of the Sublett Range. Most of the hawks' range consisted of agricultural land used for growing alfalfa and grain or as pasture for sheep, horses, and cattle. Much of the land near the foothills supported a sage-grass (*Artemisia tridentata-Agropyron cristatum*) community which was grazed by cattle. The topography of the range was essentially flat but sloped

gently from the foothills in the west to Deep Creek in the east.

Results and Discussion

Activity Periods. Few authors have commented on the activity periods of nesting Ferruginous Hawks. The only attempt at a quantitative analysis was that of Smith and Murphy (1973), which was apparently based on very little data. They indicated that the hawks hunted actively only for three hours in the morning (0600 to 0900) and three hours in the evening (1800 to 2100). They recorded essentially no activity during the remainder of the day.

My observations on the activities of the male hawk are presented in Figure 1. Figure 1a gives the distribution of time spent away from the nest area. Most of this time was spent actively hunting, although some of the mid-day soaring flights may have represented exploratory behavior. Figure 1b indicates the average number of observed strikes per hour of observation time. It is apparent that the bird foraged actively throughout the day, but with definite peaks in the morning and evening. The very low number of strikes during the mid-day period was due both to reduced hunting activity and to the difficulty I had in observing the hawk at this time. Heat wave distortion at mid-day greatly reduced my visual range, and it occurred at a time when the hawk tended to range more widely, often in high altitude flight. During this period the bird was frequently lost to view. Consequently, I witnessed a smaller proportion of his strike attempts at mid-day than in the morning or evening, when viewing conditions were greatly improved. Figure 1c presents the hourly rate at which the male brought prey items to the nest. This curve parallels Figure 1b except during the mid-day period, for the reasons given above.

The size of each prey item may have a bearing on the duration of the hawk's activity periods. On my study area, the largest available prey were Townsend's ground squirrels (*Spermophilus townsendii*) and northern pocket gophers (*Thomomys talpoides*). Other studies have indicated that jackrabbits (*Lepus* sp.) are the major prey (by biomass) of Ferruginous Hawks in areas less disturbed by man (e.g. Smith and Murphy 1973). The smaller average size of available prey in my study area may have forced the male to spend more time foraging in order to meet his own food requirements, as well as those of his mate and young. The fact that the female did not hunt may also have placed a greater burden on the male and increased his hours of activity.

Hunting Methods. I observed a total of 430 attempts at prey capture by the male. These have been grouped, in this analysis, according to the bird's hunting method. Hunting methods are distinguished by the position of the hawk at the initiation of the strike. Despite some variability within each strike type, this criterion allowed the division of total strikes into four easily recognizable techniques. These are: hunting from a perch, from the ground, from low altitude, and from high altitude (soaring) flight.

(1) *Hunting from a perch.* The male used wooden fence posts exclusively as hunting perches. Other potential perches (telephone poles, abandoned buildings

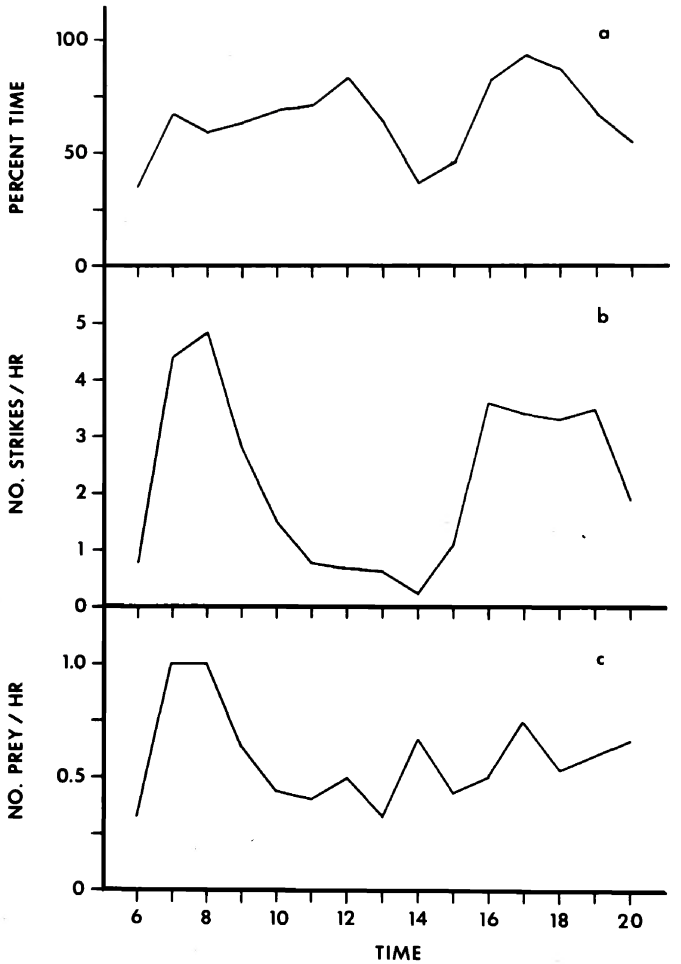

Figure 1. Three indicators of the male's activity periods: (a) percent of time spent away from the immediate vicinity of the nest, (b) time distribution for all observed strikes, (c) time distribution for all prey returned to the nest. Abscissa gives time at start of hourly interval (6 = 0600, 12 = 1200, etc.).

and farm machinery, and scattered trees and shrubs) were largely ignored. On one occasion, I observed the hawk perched on a telephone pole but no strikes were attempted, and the bird left after a few minutes. The male frequently perched on the scattered juniper trees near the nest but was never observed hunting there, despite the presence of prey as revealed by trapping.

When attempting to capture a detected prey item, the hawk would leave his perch with one or more shallow wing beats, glide for a distance at altitudes often less than 1 m, and strike with the feet, usually raising a cloud of dust on impact. The distance between perch and prey varied from less than 10 m to more than 100 m. If the strike was unsuccessful, the bird often flew directly to another perch after the brief impact. Successful strikes were marked by an abrupt stop, occasionally sending the bird sprawling in the dirt.

(2) *Hunting from the Ground.* Strikes from a perch and from the ground were frequently interspersed in a single hunting effort. The bird probably hunted from the ground only in places where he had previously detected a rodent at the entrance to its burrow. The limited strike distance (usually about 1 m) may have made this technique unsuitable in an area of unknown prey activity.

On the ground, the hawk either sat with his belly in contact with the dirt, or stood, usually with his body in a near horizontal posture. The bird seldom moved; all attention seemed to be focused on the entrance to a particular burrow. The strike itself was an instantaneous lunge at the prey, always using the feet.

(3) *Hunting from Low Flight.* At the beginning of the study, I arbitrarily defined low altitude as less than about 30 m. It soon became apparent that this was a useful distinction, and one which was easily made in the field. Relatively few flights occurred at this borderline altitude except when the bird changed from high to low flight, or vice versa. Most high altitude flights were well above 100 m. Most low altitude flights were below 20 m.

Upon detection of prey, the hawk in low flight would descend at an angle which varied according to the bird's distance from the prey item. Prey animals directly beneath the bird elicited a near vertical dive and an apparent hard impact. Usually, however, the descent was at less than 45 degrees, and a short, low-level glide often preceded the actual impact. As with strikes from a perch, after unsuccessful capture attempts the hawk usually continued his flight without landing. A successful capture brought the bird to an immediate halt.

(4) *Hunting from High Flight.* High altitude flights were those greater than 30 m; however, most were greater than 100 m. High altitude strikes differed from the others in the greater time between detection and attempted capture of the prey item. Strikes from a perch, the ground, or low flight, appeared to be almost instantaneous responses to the stimulus of a vulnerable prey. At high altitudes, however, the bird may have to choose whether or not to strike based on the amount of time the prey animal is exposed.

Most high altitude strikes were initiated from stationary, hovering flight. Hovering was frequent but only seldom resulted in a strike. The vertical descent was usually slow, the hawk floating on partially folded wings. The bird would often

hover briefly at intermediate levels in his descent, perhaps reacting to movements of his prey. The final phase of the descent was usually near vertical, but occasionally the hawk glided a few meters at low level before impact.

Predatory Efficiency. Predatory efficiency is the ratio of successful strikes to total attempted strikes. For the majority of raptors this ratio is unknown. Lambert (1943) and Ueoka and Koplin (1973) calculated an over-all efficiency of 89 and 82 percent, respectively, for the American Osprey (*Pandion haliaetus*). Similarly, Collopy (1973) recorded a 51 percent success rate for American Kestrels (*Falco sparverius*) in northern California. An average efficiency of 7.6 percent was determined by Rudebeck (1951) for four European raptors (*Accipiter nisus, Falco columbarius, F. peregrinus,* and *Haliaeetus albicilla*). My observations are apparently the first for a *Buteo.*

Table 1 summarizes the outcome of all observed strikes by the male Ferruginous Hawk. The data have been grouped under the four hunting methods described in the last section. I determined an over-all efficiency of about 15 percent. However, success rate varied according to the hunting method employed. Statistically significant differences are indicated in Table 1. The test was a chi-square with a partitioned contingency table (Cochran and Cox 1957).

Hunting from the ground was the most successful technique, probably because of the very short striking distance involved, plus the fact that the bird's attention was apparently focused on a particular prey individual which had been previously observed to be active. Hunting from a perch was the most common,

Table 1. Outcome of all attempted strikes for which hunting method was known.

Hunting from:	Total Strikes	Successful Strikes	Unknown Strikes	Success Rate†	Significance Level
Ground	81	21	1	26.2%	***
Perch	178	16	5	9.2%	**
Low Flight	120	14	10	12.7%	*
High Flight	51	10	3	20.8%	NS
Total	430	61	19	14.8%	

† Strikes of unknown success were omitted from the total.
* Significant at .10 level, but not at .05.
** Significant at .05 level.
*** Significant at .01 level.
NS Not significant.

but least successful, hunting method. The low success was probably due to the longer striking range and the necessity of scanning a relatively large area in search of prey. The technique requires relatively little energy expenditure, however, which may explain its frequent use.

Due to the great capture distance involved, strikes from high altitude are probably attempted only on the most vulnerable prey. For this reason, one might expect that the rate of success from high altitude would be greater than that at low altitude, where a strike may be an immediate response to the stimulus of a prey animal. The relative success rates for high and low flight, given in Table 1, tend to support this hypothesis, but the difference is not significant.

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